REMARKS

Claims 10 and 16 stand rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Applicant has amended claims 10 and 16 to more clearly identify the subject matter claimed by the present application. Applicant submits that no new matter was added by this amendment.

Claim 11 has been amended to replace "natural biological" with -- genetically engineered--. Support for this amendment is found in original claim 26. Applicant submits that no new matter was added by this amendment.

Claims 1-4, 11, 12, 21, 23, 26, 27, 28, 29 stand rejected under 35 U.S.C. 102(e) as being anticipated by Discher (U.S. Patent 6,835,394). The claims of the present application are directed to a block copolymer matrix simulating a natural biological membrane and natural protein environment having membrane proteins incorporated into said matrix to form a membrane/protein composite. The membrane described by Discher does not specify a membrane that simulates a natural protein environment. The membrane described by Discher includes diblock and triblock copolymers for the formation of vesicles or "encapsulating membranes" for use in "encapsulation applications". The membrane described in claim 1 is inherently different in that these biomimetic membranes must be a tri-block copolymer, preferably consisting of hydrophilic-hydrophobic-hydrophilic regions, which simulate the natural protein environment that is necessary for protein incorporation within the polymer matrix. A diblock copolymer

would not be able to form a biomimetic membrane that is amenable to protein reconstitution as a diblock copolymer only has two regions, and transmembrane proteins require 3 regions (e.g. hydrophilic-hydrophobic-hydrophilic) in order to refold properly and embed into the membrane. Thus, the membrane described in Discher do not describe biomimetic membranes for the purpose of protein incorporation, but for **encapsulation**, since the biomolecules described in Discher are not membrane proteins, but globular proteins such as hemoglobin and myoglobin.

Claims 2-3 are rejected as being anticipated by Discher because "the membrane composite (polymersome) of Discher constitutes a composite device which inherently functions depending on the encapsulated protein." The function claimed by Discher in column 4, lines 53-64 are listed as "delivery or storage of drug or other compositions, such as oxygen, to the patient via the bloodstream, gastrointestinal tract, or other tissues, as replacement artificial tissue or soft biomaterial, as optical sensors, and as structural basis for metal or alloy coatings to provide materials having unique electric or magnetic properties for use in high-dielectric or magnetic applications or as microcathodes." A membrane/protein composite with incorporated proteins is claimed in the present application, not **encapsulated** proteins. The key difference here is that incorporated means that the proteins are reconstituted into the membrane itself, where the preferred hydrophilic-hydrophobic-hydrophilic regions of the membrane mimic a natural cell membrane such that the protein can refold while embedded within the polymer block. **Encapsulated** proteins are not embedded within the actual membrane itself, but rather, the polymer forms a vesicle (like a sphere) that surrounds proteins which are free to float around within the polymer vesicle. If one were to imagine a living cell, proteins embedded in the membrane are transmembrane proteins, such as Bacteriorhodopsin, COX, and aquaporin. The function of membranes with such proteins embedded depend on the actual function of such

proteins, whereby these molecular machines are doing actual work, such as proton pumping, electron transport, or water filtering. The function of **encapsulated** protein is generally for drug delivery whereby the encapsulated protein is delivered by the polymer vesicle and then allowed to diffuse outward so that proteins can be delivered to a specific location in small quantities. The living cell analogue to this is the lysosome, which is a vesicle that contains acids and enzymes, and migrates within a cell until it encounters foreign objects to which the acids and enzymes are delivered to break the foreign invader down. Thus, the inherent function of incorporated and **encapsulated** proteins is different.

Claim 4 is directed to a water filter based upon the inherent functionality of a membrane protein which only allows water to pass through. The Discher patent discloses polymer swelling test conducted to analyze the water permeability of the diblock copolymer comprised of ethylene oxide and ethylethylene (column 20, lines 38-59). It was found that his diblock copolymer was "substantially less permeable to water than phospholipids membranes," but water transport out of the vesicles was still measurable given a high osmotic gradient. The "beneficial applications' suggested by Discher from the water permeability of vesicles does not necessarily suggest use as a water filter, since the goal of a water filter is to separate water from other molecules, but in the experiment described by Discher, water flows out of the vesicle (low glucose concentration) into the surrounding mediuim (high glucose concentration). The goal of a water filter is to separate the glucose from water. Furthermore, the relationship between polymer thickness and water permeability has been widely studied, and accordingly, polymers with higher molecular weights than natural lipid membranes exhibit much lower water permeability and fluidity. The water filter thus claimed depends on a triblock copolymer specifically designed to resist water permeability, thus forcing water out through the incorporated protein instead.

Claims 12 and 29 are directed to proteins incorporated into the matrix, or in other words, embedded within the polymer matrix itself. The Discher reference discloses the **encapsulation** of two proteins, myoglobin and hemoglobin, within a polymer vesicle, much like a polymer shell surrounding a solution of protein inside. Moreover, membrane proteins only retain their inherent function when they are properly refolded within a membrane. When the membrane proteins are free to float in solution, the protein structure unfolds and the membrane protein loses functionality. Thus, the underlying technology of the claims of the present application differs from that anticipated by the Discher reference.

Claim 21 is directed to a hybrid organic/inorganic power source having an organic part comprised of membrane proteins and an inorganic aspect described by the polymer. The Discher reference is directed to mixtures made of the "copolymer amphiphiles with other synthetic or non-synthetic amphiphiles, such as lipids or proteins" (column 30, 2nd paragraph). In this section, Discher explains that phosphatidylethanoiamine was incorporated with the EO-EE diblock copolymer. Phosphatidylethanoiamine is a lipid which was labeled with a fluorescent Texas-Red dye. Besides incorporating lipid with a diblock, Discher does not make any further mention of incorporating any other amphiphiles with the polymer. In fact, only a very narrow range of amphiphiles can be incorporated into said diblock, as dimensions of the amphiphile as well as the dimensions of the hydrophilic-hydrophobic regions of the amphiphile have to match up with the corresponding regions of the diblock membrane. Ultimately, this section has no relevance to a "hybrid organic/inorganic power source" as provided in claim 21.

Claims 23, 26, 27 and 28 are also rejected based on Discher. However, the Discher reference does not anticipate the use of membrane proteins as a potential power source, nor does

it mention the use of genetic engineering of proteins to optimize insertion and orientation of said proteins into the matrix.

For the foregoing reasons, Applicant submits that all of the rejections have been overcome and requests reconsideration and allowance of the claims.

Claim 21 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Discher et al (U.S. 6,835,394). Claim 21 is directed to a hybrid organic/inorganic power source having an organic part comprised of membrane proteins and an inorganic aspect described by the polymer. The Discher reference is directed to mixtures made of the "copolymer amphiphiles with other synthetic or non-synthetic amphiphiles, such as lipids or proteins" (column 30, 2nd paragraph). In this section, Discher explains that phosphatidylethanoiamine was incorporated with the EO-EE diblock copolymer. Phosphatidylethanoiamine is a lipid which was labeled with a fluorescent Texas-Red dye. Besides incorporating lipid with a diblock, Discher does not make any further mention of incorporating any other amphiphiles with the polymer. In fact, only a very narrow range of amphiphiles can be incorporated into said diblock, as dimensions of the amphiphile as well as the dimensions of the hydrophilic-hydrophobic regions of the amphiphile have to match up with the corresponding regions of the diblock membrane. Ultimately, this section has no relevance to a "hybrid organic/inorganic power source" as provided in claim 21. Applicant submits that it would not be obvious to one of skill in the art to provide the device of Discher with the desired function or use based on Discher's suggestion to use synthetic on non-synthetic proteins. The Examiner has not provided any motivation in the prior art that would lead one to

the power source claimed in the present application. Therefore, Applicant submits that the rejection has been overcome and requests reconsideration and allowance of the claims.

Claims 5, 7, 8, 13, 14, 15, 17, 18-20, 22-25, 30 would be allowable if rewritten or amended to overcome the rejection(s) under 35 U.S.C. 112, 2nd paragraph, set forth in the Office Action. Applicant submits that the independent claims upon which these claims depend are allowable. Therefore, Applicant submits that this rejection has been overcome and requests reconsideration and allowance of the claims.

Claims 10 and 16 would be allowable if rewritten to overcome the rejection(s) under 35 U.S.C. 112, 2nd paragraph, set forth in this Office action to include all of the limitations of the base claim and any intervening claims. Claims 10 and 16 have been amended to overcome the rejection based on 35 U.S.C. 112, 2nd paragraph. Additionally, Applicant submits that the independent claims upon which these claims depend are allowable. Therefore, Applicant submits that this rejection has been overcome and requests reconsideration and allowance of the claims.

In view of the foregoing, Applicant respectfully submits that the art rejections are overcome and that the application is now in condition for allowance. Accordingly, favorable reconsideration and allowance of the application is respectfully requested.

Respectfully submitted,

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